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TH3098 (US)
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the application of	)	
	)	
KE LIU ET AL	)	
	)	
Serial No. 10/658,494	)	Group Art Unit: 1793
	)	
Filed September 8, 2003	)	Examiner: Edward Johnson
	)	
INTEGRATED NOx TRAP AND PARTICULATE FILTER FOR INTERNAL COMBUSTION ENGINES	)	April 16, 2009

COMMISSIONER FOR PATENTS
P. O. Box 1450
Alexandria, VA 22313-1450

Sir:

REVISED APPEAL BRIEF

Applicants hereby submit this Revised Appeal Brief in order to appeal the final rejection of claims 1, 8-9 and 11 of the present application, made in the final office action mailed June 3, 2008. This Brief has been revised to refer to the drawings by reference character in the summary of the claimed subject matter. Applicants respectfully request that the final rejection of the Examiner be reversed and that the application be sent back to the Examiner for allowance.

Real Party in Interest

The real party in interest is Shell Oil Company as evidenced by the assignment set forth at Reel 017996, Frame 0629.

Related Appeals and Interferences

To the best of the undersigned's knowledge, there are no related appeals or interferences.

Status of the Claims

Claims 1-7 were originally presented for examination. Claims 8-11 were added during prosecution. Claims 2-7 and 10 were canceled. The rejection of claims 1, 8-9 and 11 is appealed.

Status of Amendments

No amendments to the claims have been filed.

Summary of Claimed Subject Matter

The invention as set forth in claim 1 is directed to a method of reducing both NO_x and particulates in the exhaust of hydrocarbon-burning internal combustion engines. *See* p. 5, lines 2-11. The method comprises providing in the exhaust stream of an internal combustion engine at least one porous, interdigitated ceramic filter. *See* p. 11, lines 7-17 and Figure 7, reference 127. The filter includes a plurality of inlet channels (*see* Figure 7, reference 130) and a plurality of outlet channels (*see* Figure 7, reference 133) contiguous with said inlet channels. *See* p. 6, lines 3-9. The filter has NO_x adsorbent material and NO_x reduction catalyst disposed on or in at least one of (a) on the surfaces of said channels or (b) within the pores of said filter or (c) within the material of which said filter is composed. *See* p. 6, lines 10-15. The method comprises alternatively providing to each of the inlet channels syngas and the exhaust in an interleaved fashion. *See* p. 11, line 18 to p. 12, line 23. This results in regenerating the NO_x adsorbing material and catalytically burning particulates trapped in the filter. *See* p. 12, lines 3-11. Both syngas and the exhaust are simultaneously provided to the filter. *See* p. 9, lines 9-12.

Grounds of Rejection to be Reviewed on Appeal

In the office action, claims 1, 8-9 and 11 were rejected under 35 U.S.C. §103(a) as being unpatentable over Maunula, US 2002/0054843 (hereinafter the '843 publication) in view of Buchanan et al., US 5,591,417 (hereinafter the '417 patent). The rejection of claims 1, 8-9 and 11 is appealed.

Argument

Rejection of Claims 1, 8-9 and 11 under 35 USC 103(a)
over the '843 publication in view of the '417 patent

There is no teaching or suggestion in the Buchanan reference of using syngas to regenerate a NOx adsorbing material used to treat the exhaust from an internal combustion engine. With respect to the reduction of nitrogen oxide, the focus in Buchanan is to reduce the amount of nitrogen oxide formed during combustion in the combustor. Neither the Buchanan reference or the Maunula reference provide any reason as to why the skilled person would use the reducing gas (e.g., syngas) of Buchanan, which is used to regenerate the solid sulfur oxide sorbent, in the system of Maunula, which regenerates the NOx adsorption catalyst through the use of a lean-rich (air/fuel) mixture combination in the engine.

Further, Maunula does not teach or suggest a porous, interdigitated ceramic filter including a plurality of inlet channels and a plurality of outlet channels contiguous with said inlet channels and simultaneously providing both syngas and exhaust gas to the filter so that within the filter NOx and particulates are being reduced in the exhaust gas and the NOx adsorbing material is being regenerated and the trapped particulates are being catalytically burned. The Maunula reference merely teaches periodic regeneration by changing the process conditions (e.g., feedstream content) experienced by the whole operational unit (e.g., NOx adsorber or particle separator). The Buchanan reference also merely discloses periodic regeneration by changing the content of the feedstream to the whole solid sulfur oxide sorbent bed. The Examiner submits that "there would obviously, to one of ordinary skill, be at least some exhaust gas leftover at the beginning of 'periodic' regeneration." (emphasis added). The leftover exhaust gas does not anticipate or render obvious the claim of the present application that claims simultaneously providing both syngas and exhaust gas to the filter or as described in the specification as filed, "the engine exhaust and the syngas are both flowing simultaneously, all of the time." See p. 9, lines 9-12.

Advantages of the present invention include removing oxides of nitrogen and sulfur from internal combustion engine exhaust with a minimum usage of syngas and providing effective and efficient removal of oxides of nitrogen, sulfur and particulates from the exhaust. These advantages result from the discovery that the use of syngas for regeneration of NOx adsorbent material can also accommodate the utilization of syngas for catalytic burning of particulates in a filter. Also, use of a porous interdigitated ceramic filter having outlet channels contiguous with inlet channels allows for mixing of the exhaust gas and syngas in the outflow interdigitated channels which are at the gas interface of the inlet for the exhaust gas and the inlet for the syngas. This mixing of the exhaust gas with highly concentrated syngas in the presence of catalytic combustion can produce a higher temperature at the point of mixing within the channels, sufficient to decompose the sulfur compounds trapped by the NOx adsorbing material which results in improved regeneration. *See Application text*, as filed, page 5, lines 2 – page 6, line 9; page 11, line 20 – page 12, line 18. This is an unexpected advantage over the cited references.

Regarding the regeneration of the NOx adsorber, the Maunula reference teaches to remove nitrogen oxides and sulfates from the NOx adsorber with a lean-rich mixture sequence. *See* U.S. Patent Application Publication No. 2002/0054843, page 2, paragraph 21; page 2-3, paragraph 27. Regarding the regeneration of the particle separator, the Maunula reference teaches to remove the soot by using different process conditions such as a high NO2/C ratio in the feedstream or even thermal combustion with oxygen to remove the soot. *See Id.* at page 3, paragraph 40; page 4, paragraphs 44-46. The Buchanan reference is silent regarding the regeneration of a NOx adsorbent as well as the regeneration of a particulate trap. Neither Maunula nor Buchanan provide any reasoning such that the skilled person would combine the Maunula and Buchanan references to arrive at the present invention, in particular to use a porous interdigitated ceramic filter having outlet channels contiguous with inlet channels and containing both a NOx adsorbent material and a NOx reduction catalyst while simultaneously providing exhaust gas for removal of NOx and particulates and syngas for regenerating the NOx adsorbing material and catalytically burning particulates trapped in the filter. Accordingly, Applicants submit that the claims are patentable over the cited references.

In conclusion, the Examiner has not met his burden of showing that the claims of the application are *prima facie* obvious over the cited prior art. Therefore, the Applicants respectfully request that the application be allowed on the existing claims and that prosecution remain closed.

Respectfully submitted,

KE LIU ET AL

By their attorney: /James D. Carruth/
James D. Carruth
Reg. No. 55,038
Shell Oil Company
(713) 241-0135

P.O. Box 2463
Houston, Texas 77252

CLAIMS APPENDIX

1. A method of reducing both NO_x and particulates in the exhaust of hydrocarbon-burning, internal combustion engines, comprising:

providing in the exhaust stream of an internal combustion engine at least one porous, interdigitated ceramic filter including a plurality of inlet channels and a plurality of outlet channels contiguous with said inlet channels, and having NO_x adsorbent material and NO_x reduction catalyst disposed on or in at least one of (a) on the surfaces of said channels or (b) within the pores of said filter or (c) within the material of which said filter is composed; and

alternatively providing to each of said inlet channels syngas and said exhaust in an interleaved fashion, thereby to regenerate said NO_x adsorbing material and to catalytically burn particulates trapped in said filter, wherein both syngas and said exhaust are simultaneously provided to said filter.

8. The method of claim 1, wherein the NO_x adsorbent material comprises barium carbonate.

9. The method of claim 1, wherein the NO_x reduction catalyst comprises platinum.

11. The method of claim 1, wherein syngas is provided to between 0.5% and 50% of said inlet channels.

EVIDENCE APPENDIX

[None]

RELATED PROCEEDINGS APPENDIX

[None]